Did you know?
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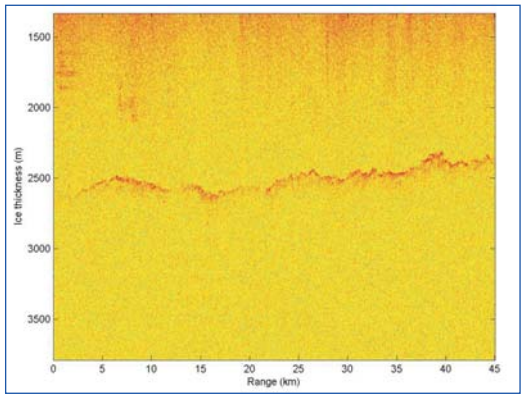
Interferometric Radar Achieves Several 'Firsts' in Greenland Airborne Demonstration

The Global Ice Sheet Mapping Orbiter (GISMO), a NASA ESTO-funded instrument designed by a team of investigators from The Ohio State University, The University of Kansas, JPL and Vexcel Corporation, successfully completed over 40 hours of airborne testing in September 2007. GISMO was flown on NASA's P-3 aircraft over Greenland's varied glacier areas – from the dry northern interior ice sheet to the seasonally melted center / southern sheet to crevassed zones – to demonstrate its ability to make 3-dimensional measurements of the thickness and base (basal) topography beneath an ice sheet up to 5 km deep.

Initial looks at the returned data indicate that the instrument performed very well. GISMO, which looks both directly downward and to both sides along the flight path, has produced the first airborne interferograms of an ice sheet base as well as the first 3-dimensional ice thickness measurements. In fact, GISMO is the first demonstration of a simultaneous-left-right-down-looking synthetic aperture radar (SAR). The current method of ice sheet base sounding, using a single down-looking radar, restricts data to the thin line of the flight path and produces images that are essentially two-dimensional.

Jacobshavn Glacier terminus (on right). Icebergs clog the fjord downstream of the glacier (on left). GISMO took two flights over portions of Jacobshavn.



A 45 km section, proceeding from east to west, of 450 MHz data across Greenland's North East Ice Stream taken from an altitude of 500 m. Note the dark orange line that denotes the ice sheet base.

GISMO employs VHF (150 MHz) and P-band (450 MHz) interferometric radars and both frequencies were used on alternating flights during the demonstrations. The P-3 aircraft ferried GISMO from 500 to 4,400 m above the ice sheet surface on eight individual flights, enabling observations to evaluate the swath width of the instrument at various operating frequencies and elevations.

The GISMO team is using the data from the test flights to further evaluate the data-filtering techniques and algorithms necessary for this kind of measurement. They are also examining the images for the radar signature that denotes water beneath the ice sheets – the basal water signature. A reliable, broad-scale measurement of basal water is of particular interest to scientists, especially to what extent meltwater lubricates moving ice sheets and glaciers.

This airborne demonstration represents a large step toward proving the GISMO concept for a future space-based radar system. Such a system could provide the data needed to estimate the volume of Earth's ice sheets and measure basal changes over very long (decadal) time scales – measurements that will be key ingredients for future ice sheet prediction capabilities. The technology also forms the basis for instruments that could measure the Mars ice sheet or map the ocean beneath the icy surface of Jupiter's moon, Europa.

The GISMO project is in its third year of ESTO funding under the Instrument Incubator Program and receives additional support for radar development from the National Science Foundation. For more information on emerging NASA technologies, visit http://esto.nasa.gov